

CLAIMS

We claim:

1. A resin formulation useful for forming shaped articles and/or molded snacks, comprising:

5 a shelf-stabilizing agent including a hydrolyzed protein moiety and selected from the group consisting of hydrolyzed protein, hydrolyzed protein derivatives, and hydrolyzed protein/hydrolyzed protein derivative-emulsifier complexes,

the shelf stabilizing agent being present in an amount ranging from 0.5% to
10 25% by weight of the resin formulation; and
grain protein ranging from 20% to 80% by weight of the resin formulation.

2. The resin formulation of Claim 1 shaped into a one of an edible product and a biodegradable product according to a process that includes at least one step of injection molding the resin formulation or extruding the resin formulation.

15 3. The resin formulation of Claim 1 shaped to form a pet chew treat.

4. The resin formulation of Claim 1, wherein the shelf-stabilizing agent comprises the hydrolyzed protein.

20 5. The resin formulation of Claim 4, wherein the hydrolyzed protein is selected from the group consisting of hydrolyzed wheat gluten, hydrolyzed soy protein, hydrolyzed corn gluten, hydrolyzed potato protein, hydrolyzed rice protein, hydrolyzed gelatin protein, hydrolyzed collagen, hydrolyzed casein, hydrolyzed whey protein, hydrolyzed milk protein, hydrolyzed egg white, hydrolyzed egg yoke, hydrolyzed whole egg, hydrolyzed chicken liver, hydrolyzed pork liver, hydrolyzed beef liver, hydrolyzed fish liver, hydrolyzed meat protein of any source, hydrolyzed fish, hydrolyzed blood plasma, and mixtures thereof.

25 6. The resin formulation of Claim 4, wherein the hydrolyzed protein comprises hydrolyzed liver protein.

7. The resin formulation of Claim 4, wherein the amount of hydrolyzed protein ranges from 1% to 25 % by weight.

8. The resin formulation of Claim 4, wherein the amount of hydrolyzed protein ranges from 1.5% to 20 % by weight.

5 9. The resin formulation of Claim 4, wherein the amount of hydrolyzed protein ranges from 2% to 15 % by weight.

10. The resin formulation of Claim 1, wherein the shelf-stabilizing agent comprises the hydrolyzed protein derivative.

11. The resin formulation of Claim 10, wherein the hydrolyzed protein derivative comprises a reaction product of a protein hydrolysate with at least one reagent selected from the group consisting of an anhydride, ethylene oxide, propylene oxide, fatty acid, reducing sugars, maltodextrin, oligosaccharide, and dextrin.

12. The resin formulation of claim 11, wherein the hydrolyzed protein derivative contains from 0.5% to 50% hydrolyzed protein by weight of the reaction product.

13. The resin formulation of Claim 11, wherein the hydrolyzed protein derivative is a derivative of liver protein hydrolysate.

14. The resin formulation of Claim 10, wherein the hydrolyzed protein derivative ranges from 1% to 25 % by weight of the resin formulation.

20 15. The resin formulation of Claim 10, wherein the hydrolyzed protein derivative ranges from 1.5% to 20 % by weight of the resin formulation.

16. The resin formulation of Claim 10, wherein the hydrolyzed protein derivative ranges from 2% to 15 % by weight of the resin formulation.

25 17. The resin formulation of Claim 1, wherein the shelf-stabilizing agent comprises the hydrolyzed protein /hydrolyzed protein derivative-emulsifier complex.

18. The resin formulation of Claim 17, wherein the hydrolyzed protein /hydrolyzed protein derivative-emulsifier complex comprises hydrolyzed protein/hydrolyzed protein derivatives contacting an emulsifier selected from the group consisting of hydrolyzed vegetable oil, hydrolyzed animal fat, hydrolyzed 5 lecithin and their salt forms, hydrolyzed lecithin modified further by ethylene oxide and propylene oxide, ethoxylated mono- and diglycerides, diacetyl tartaric acid ester of mono-diglycerides, sugar esters of mono- and diglycerides, propylene glycol mono- and diesters of fatty acids, calcium stearoyl-2-lactylate, lactyl stearate, sodium stearoyl fumarate, succinylated monoglyceride, sodium stearoyl-2-lactylate, 10 polysorbate 60, or any other emulsifier that contains both hydrophobic and hydrophilic portions in the structure, and mixtures thereof.

19. The resin formulation of Claim 18, wherein the emulsifier ranges from 10%-30 % by weight of the hydrolyzed protein /hydrolyzed protein derivative-emulsifier complex.

15 20. The resin formulation of Claim 16, wherein the hydrolyzed protein/hydrolyzed protein derivative-emulsifier complex contains a liver protein hydrolysate.

21. The resin formulation of Claim 16 wherein the hydrolyzed protein /hydrolyzed protein derivative-emulsifier complex ranges from 1% to 25 % by weight 20 of the resin formulation.

22. The resin formulation of Claim 16 wherein the hydrolyzed protein /hydrolyzed protein derivative-emulsifier complex ranges from 1.5% to 20 % by weight of the resin formulation.

23. The resin formulation of Claim 16, wherein the hydrolyzed protein /hydrolyzed protein derivative-emulsifier complex ranges from 2 to 15 % by weight 25 of the resin formulation.

24. The resin formulation of Claim 4, wherein the hydrolyzed protein moiety has a weight average molecular weight less than or equal to 20 KDa and a number average molecular weight less than or equal to 10 KDa.

25. The resin formulation of Claim 10, wherein the hydrolyzed protein moiety has a weight average molecular weight less than or equal to 20 KDa and a number average molecular weight less than or equal to 10 KDa.

26. The resin formulation of Claim 17, wherein the hydrolyzed protein 5 moiety has a weight average molecular weight less than or equal to 20 KDa and a number average molecular weight less than or equal to 10 KDa.

27. The resin formulation of Claim 1, wherein the grain-based protein is selected from the group consisting of wheat gluten, corn gluten, soy protein, and mixtures thereof.

10 28. The resin formulation of Claim 1, wherein the grain-based protein comprises wheat gluten.

29. The resin formulation of Claim 1, wherein the grain-based protein ranges from 20% to 80 % by weight of the resin formulation.

15 30. The resin formulation of Claim 1, wherein the grain-based protein ranges from 30% to 75% by weight of the resin formulation.

31. The resin formulation of Claim 1, further comprising a plasticizer ranging from 10% to 40 % by weight of the resin formulation.

20 32. The resin formulation of Claim 31, wherein the plasticizer is selected from the group consisting of glycerol, diglycerol, propylene glycol, triethylene glycol, urea, sorbitol, mannitol, maltitol, hydrogenated corn syrup, polyvinyl alcohol, polyethylene glycol, and mixtures thereof.

33. The resin formulation of Claim 1, further comprising water ranging from 5% to 12 % by weight of the resin formulation.

25 34. The resin formulation of Claim 1, further comprising a lubricant ranging from 0.5% to 5 % by weight of the resin formulation.

35. The resin formulation of Claim 34, wherein the lubricant is selected from the group consisting of glycerol mono/di-stearate, hydrolyzed lecithin, hydrolyzed lecithin derivatives, fatty acid, fatty acid derivatives, and mixtures thereof.

36. The resin formulation of Claim 1, further comprising a mold release agent ranging from 0.5% to 3 % by weight of the resin composition.

37. The resin formulation of Claim 36, wherein the mold release agent is selected from the group consisting of magnesium stearate, calcium stearate, barium stearate, alkaline earth metal fatty acids, and mixtures thereof.

38. The resin formulation of Claim 1, further comprising a reducing agent ranging from 0.5% to 5 % by weight of the grain protein.

39. The resin formulation of Claim 38, wherein the reducing agent is selected from the group consisting of alkali metal sulfites, ammonium sulfites, bisulfites, metabisulfites, nitrites, mercaptoethanol, cysteine, cysteamine, sulfur dioxide, ascorbic acid and mixtures thereof.

40. The resin formulation of Claim 38, wherein the reducing agent comprises sodium metabisulfite.

41. The resin formulation of Claim 1, further comprising an additional ingredient ranging up to 75% by weight of the resin formulation.

42. The resin formulation of claim 41, wherein the additional ingredient is selected from the group consisting of:

- (a) a filler including at least one of a native or chemically modified starch, calcium carbonate, heat denatured protein, vegetable powder, rice flour, wheat flour, corn gluten meal, and fibers;
- (b) pigments;
- (c) coloring agents;
- (d) foaming agents;
- (e) other special effect ingredients of predetermined functionality, and
- (f) mixtures thereof.

43. The resin formulation of claim 42, wherein the additional ingredient comprises the (a) filler including native or chemically modified starch in granular form, further selected from the group consisting of wheat starch, corn starch, potato, rice, tapioca starches, and mixtures thereof.

5 44. The resin formulation of claim 42, wherein the additional ingredient comprises the filler including the chemically modified starch as a reaction product of native starch by oxidation, acetylation, carboxymethylation, hydroxyethylation, hydroxypropylation, alkylation, and mixtures thereof.

10 45. The resin formulation of claim 42, wherein the additional ingredient filler comprises the filler including the, further selected from the group consisting of cellulose fiber, micro-crystalline fiber, soluble fibers, wheat bran, soy bean fiber, corn grit fiber, and mixtures thereof.

15 46. The resin formulation of claim 42, wherein the additional ingredient comprises the (b) pigments, further selected from the group consisting of titanium dioxide, carbon black, talc, calcium carbonate, and mixtures thereof.

47. The resin formulation of claim 42, wherein the additional ingredient comprises the (c) coloring agents, further selected from the group consisting of azo dyes, chlorophyll, xanthophyll, carotene, indigo, all the synthetic colors, natural coloring agents, and mixtures thereof.

20 48. The resin formulation of claim 42, wherein the additional ingredient comprises the (d) foaming agents, further selected from the group consisting of sodium bicarbonate, N₂, CO₂, and mixtures thereof.

49. The resin formulation of claim 42, wherein the additional ingredient comprises the (e) other special effect ingredients, further selected from the group 25 consisting of breath enhancers and dental cleaning ingredients.

50. The resin formulation of Claim 41, wherein the additional ingredient comprises a granular starch.

51. The resin formulation of Claim 50, wherein the granular starch is selected from the group consisting of corn starch, wheat starch, potato starch, rice starch, tapioca starch, and mixtures thereof.

52. The resin formulation of Claim 50, wherein the granular starch comprises a chemically modified starch.

53. The resin formulation of Claim 50, wherein the granular starch ranges from 0.001% to 70% by weight of the resin formulation.

54. A chew treat product comprising:
a shelf-stabilizing agent including a hydrolyzed protein moiety and selected
10 from the group consisting of hydrolyzed protein, hydrolyzed protein derivatives, and hydrolyzed protein/hydrolyzed protein derivative-emulsifier complexes,
the shelf stabilizing agent being present in an amount ranging from 0.5% to
25% by weight of the resin formulation; and
15 grain protein ranging from 20% to 80% by weight of the resin formulation,
the shelf-stabilizing agent and the grain protein forming a mixture that is
shaped as a pet chew treat.

55. A method of forming grain protein-based containing pellets, which can be used in injection molding equipment for the production of articles, the method
20 comprising the steps of:

(a) providing a formulation comprising from 20% to 80 % by weight grain protein, from 10 to 40 % plasticizer, and from 1% to 25 % of a shelf stabilizing agent selected from the group consisting of hydrolyzed proteins, hydrolyzed protein derivatives, hydrolyzed protein/hydrolyzed protein derivative-emulsifier complexes, and mixtures thereof;
25 (b) heating the formulation; and
(c) forming pellets by extrusion, the heating step being carried out so that the formulation is heated to a sufficient temperature in the extruder to render the formulation substantially homogeneous and flowable with
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the avoidance of any substantial heat denaturation of the grain-based protein formulation.

56. The method of Claim 55, wherein heating step is performed at a maximum temperature less than or equal to 95°C.

5 57. The method of Claim 55, wherein the formulation contains from 20% to 80 % by weight grain protein.

58. The method of Claim 55, wherein the formulation contains from 0.001% to 75% by weight of granular starch.

59. The method of Claim 55, wherein the formulation contains from 0.5%
10 to 5% of a reducing agent by weight of the grain protein.

60. The method of Claim 55, wherein the grain protein is selected from the group consisting of soy protein, wheat gluten, corn gluten, and mixtures thereof.

61. The method of Claim 55, wherein the grain protein comprises wheat gluten.

15 62. The method of Claim 58, the starch being selected from the group consisting of corn starch, wheat starch, potato starch, tapioca starch and mixtures thereof.

63. The method of Claim 55, the plasticizer being selected from the group consisting of glycerol, diglycerol, propylene glycol, triethylene glycol, urea, sorbitol,
20 mannitol, maltitol, hydrogenated corn syrup, polyvinyl alcohol, polyethylene glycol, C₁₂-C₂₂ fatty acids and metal salts of such fatty acids, and mixtures thereof.

64. The method of Claim 55, wherein the plasticizer comprises glycerol.

65. The method of Claim 55, wherein the formulation comprises a reducing agent selected from the group consisting of the alkali metal and ammonium sulfites, bisulfites, metabisulfites and nitrites, and mercaptoethanol, cysteine, cysteamine, sulfur dioxide, ascorbic acid and mixtures thereof.

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66. The method of Claim 55, wherein the formulation comprises a filler selected from the group consisting of titanium dioxide, carbon black, talc and carbonate salts.

67. The method of Claim 55, wherein the formulation contains a quantity of fiber therein.

68. The method of Claim 55, wherein the formulation contains a quantity of a lubricant/mold release agent selected from the group consisting of vegetable and animal oils and fats, the alkali metal and alkaline earth stearates and mixtures thereof.

69. The method of Claim 68, where the lubricant mold release agent is present at a level ranging from 0.5% to 3.0 % by weight of the formulation

70. The method of Claim 55, the formulation including a colorant.

71. The method of claim 55, further comprising the steps of: passing the pellets through injection molding equipment having a barrel and a mold capable of forming an article,

the passing step comprising the steps of rendering the pellets flowable in the barrel while maintaining the temperature of the flowable pellet material up to a maximum temperature less than 95°C, and heating the mold to a temperature of from 120°C to 180°C.

72. The method of Claim 71, further comprising a step of transferring the flowable pellet material into the mold to form the article.

73. The method of Claim 72, wherein the article produced in the transferring step is a pet chew treat.